Pearson BTEC Level 3 Nationals Extended Certificate, Foundation Diploma, Diploma, Extended Diploma

Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Learner Registration Number

Time 45 minutes

Paper reference **31619H**

Applied Science/Forensic and Criminal Investigation

UNIT 3: Science Investigation Skills

Part A

You must have:
A calculator and a ruler.

Total Marks

Instructions

- **Part A** contains material for the completion of the preparatory work for the set task.
- **Part A** must be issued to learners 45 minutes before the start of **Part B**.
- **Part A** is specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part A** materials for the set task will be issued prior to the start of the supervised assessment period according to the guidance in the specification.
- **Part A** should not be returned to Pearson.

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Instructions for Teachers/Tutors or Invigilators

This taskbook:

- contains the instructions for learners and the set task brief
- must be issued to learners 45 minutes before the start of **Part B**
- must not be taken out of the supervised assessment area.

Teachers/tutors or invigilators must not give any support to learners.

Learner notes will be retained securely by the centre after **Part B** has been undertaken and may be requested by Pearson if there is suspected malpractice.

Refer carefully to the instructions in this taskbook and the BTEC Nationals *Instructions for Conducting External Assessments (ICEA)* document to ensure that the preparatory period is conducted correctly and that learners have the opportunity to carry out the required activities independently.

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Instructions for Learners

You will be given 45 minutes to read Part A and make notes.

Part A contains the set task brief you need to prepare for **Part B, Section 1**.

Read the set task brief carefully.

You should use the space provided at the end of **Part A** to make notes.

You will use the set task brief in **Part A** and your notes to complete the set task in **Part B**, **Section 1**.

You must return **Part A** and **Part B** at the end of the examination.

The teacher/tutor or invigilator must not give you feedback during the time given to read and make notes for **Part A.**

Set Task Brief for Part B, Section 1

A research scientist is working at a nature reserve. The scientist is researching plants and algae that can resist drying out.

The research scientist has been asked to investigate the distribution of *Pleurococcus* and some of the factors that affect its distribution.

The scientist produces this draft report of their investigation.

Draft Report

Title

An investigation into the relationship between the directional aspect of a tree trunk and the percentage cover of *Pleurococcus*.

Aim

To measure the percentage cover of *Pleurococcus* and the light intensity, in lux, at different directional aspects of the tree trunk.

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Introduction

Pleurococcus is a widespread alga. The distribution of *Pleurococcus* depends on exposure to light, wind and water. *Pleurococcus* produces a slime that helps it to form a biofilm. This allows the alga to stick to vertical surfaces, such as tree trunks, and helps to prevent dehydration.

Pleurococcus does not have roots so it can only absorb water that runs down the tree trunk. Although *Pleurococcus* can survive some dehydration, it will only grow if hydrated. Increased light intensity increases drying because it raises the temperature and causes evaporation of water.

When choosing where I would go to collect my data, there were many factors I had to think about. Ideally it would need to be somewhere away from roads. It would need to be a public area but not too busy, so as to avoid places where people might go regularly or walk their dogs, and not too exposed to extreme weather conditions. At the same time, I wanted to find a place where the trees were easy to access and safe for me to take measurements, on flat land and away from streams and rivers.

I also had to think about when I would be taking my measurements. It would need to be bright enough for me to read my instruments and the time of year mild enough that the results would not be skewed by any extreme weather. I tried to avoid taking my measurements after recent rainfall or on days that might be too hot.

I eventually decided that I would collect my data at my local nature reserve in June. As well as a forest of large trees, the area is also home to many wild animals, including a herd of deer. I had to telephone before I went to make sure it would be safe and convenient to do my investigation at this time, specifically asking about any hazards that I should be aware of while walking around the area. As well as my scientific equipment, I also brought gloves, a map of the area, sunscreen, insect repellent, a good pair of walking boots, a bottle of water, and a guide to the local plants and fungi.

On the day of my investigation I did a risk assessment, focusing on risks from the weather conditions and checked the area where I would be working for hazards.

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Equipment

- 10 cm by 10 cm quadrat on a transparent acetate sheet
- compass
- 1 m ruler
- string
- drawing pin
- clipboard
- light meter (measuring in lux).

Method

The acetate has grid lines to give 100 small squares (Figure 1). Each small square is 1 cm by 1 cm.

The percentage cover can be estimated by counting how many squares of the quadrat have *Pleurococcus* underneath.

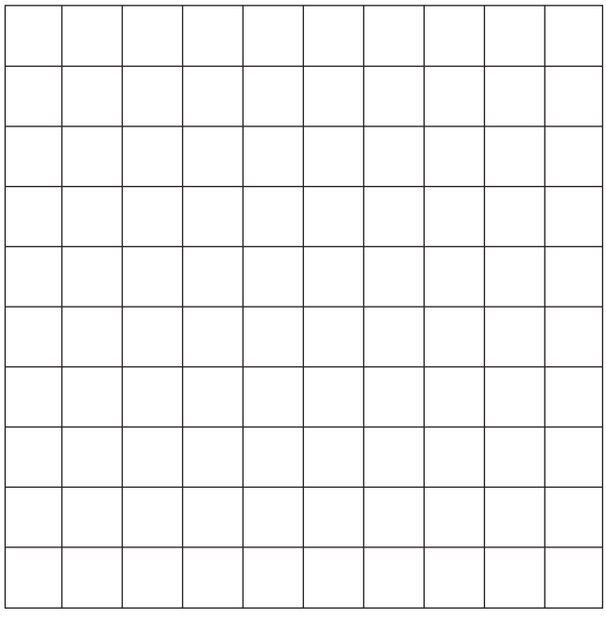

Figure 1

Figure 1 is not to scale.

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This is the method that was used to obtain the data:

1. Starting from the ground, I measured a height of 1.5 m on the trunk of a tree.
2. I tied the string around the tree at the height of 1.5 m.
3. I used the compass to identify the north side/aspect of the tree.
4. I inserted the drawing pin through the string at north (N), as shown in Figure 2.

This is the starting point for sampling around the tree trunk. The pin indicates the north side/north aspect of the tree (N).

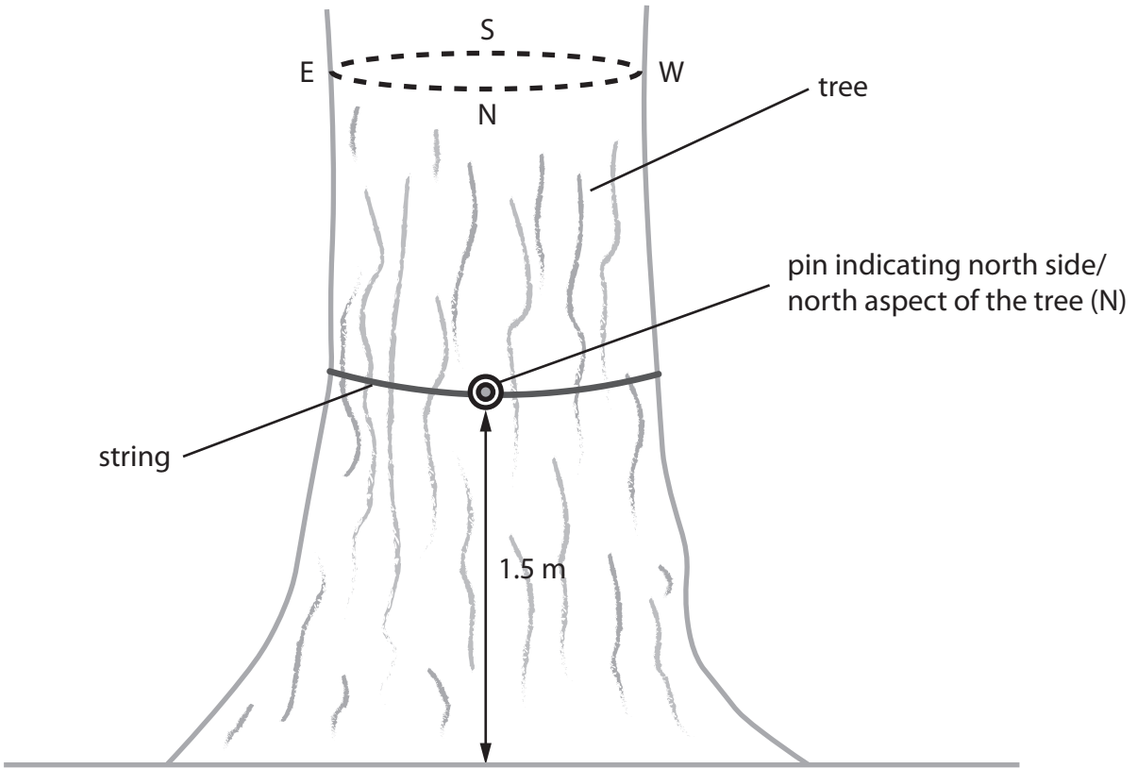

Figure 2

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5. Using a 10 cm × 10 cm quadrat, I placed the quadrat against the tree trunk, above the string, at N, as shown in Figure 3.

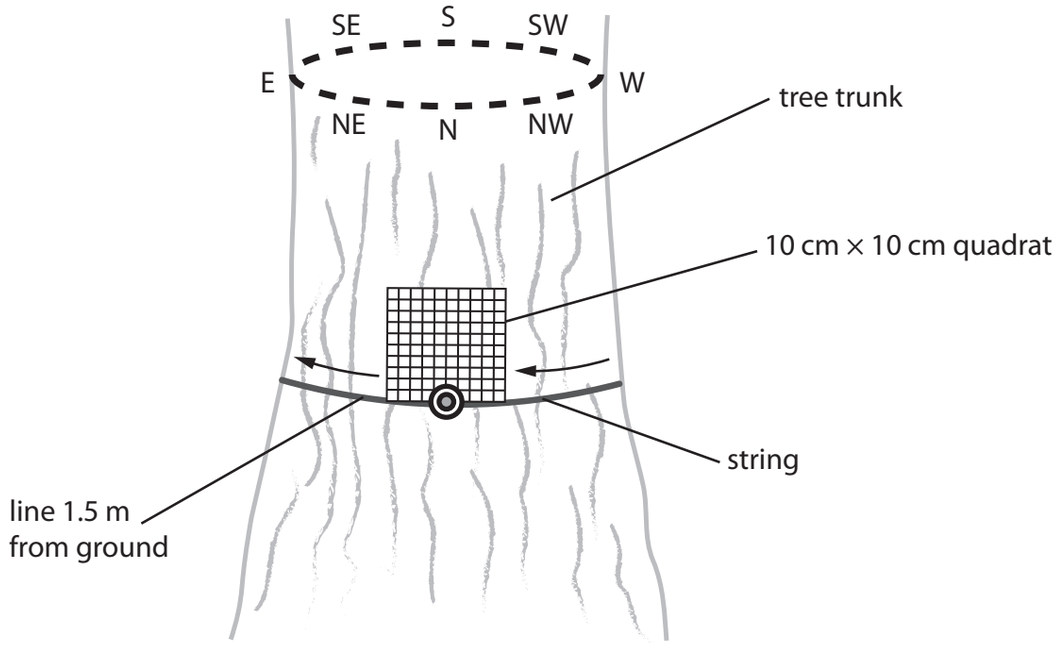

Figure 3

Figure 3 is not to scale.

6. Using the grid on the quadrat, I estimated the percentage cover of *Pleurococcus* on the tree bark, for the area covered by the quadrat.
7. I recorded the estimated percentage cover for that quadrat.
8. Using a light meter, I measured and recorded the light intensity in lux at this directional aspect of the tree trunk.
9. Using the compass, I repeated steps 6–8 for NE, E, SE, S, SW, W, NW aspects of the tree trunk.
10. I removed the drawing pin, untied the string and removed it from the tree trunk.
11. I repeated steps 1–10 for two other trees that were as close as possible to the first tree and in the same ecosystem.

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Raw data

Tree 1

	%	
N	72	7750 lux
NE	58	8220 lux
E	52	8350 lux
SE	40	8540 lux
S	34	8890 lux
SW	44	8120 lux
W	51	7950 lux
NW	70	7880 lux

Tree 2

	%	
N	76	7700 lux
NE	66	8235 lux
E	54	8370 lux
SE	46	8680 lux
S	38	9120 lux
SW	42	8460 lux
W	54	8130 lux
NW	62	7970 lux

Tree 3

	%	
N	80	7740 lux
NE	68	8200 lux
E	50	8475 lux
SE	46	8500 lux
S	36	8910 lux
SW	34	8000 lux
W	51	7760 lux
NW	72	7640 lux

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Notes

Use this space to make notes about the research scientist's draft report.

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Notes

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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Learner Registration Number

Time 1 hour 30 minutes

Paper reference **31619H**

Applied Science / Forensic and Criminal Investigation

Unit 3: Science Investigation Skills

Part B

You must have:
A calculator and a ruler.

Total Marks

Instructions

- You will need **Part A** to complete **Part B Section 1**.
- **Part A** and **Part B** contain material for the completion of the set task under supervised conditions.
- **Part A** and **Part B** must be undertaken in a single session of 2 hours and 15 minutes on the date timetabled by Pearson.
- **Part A** should be given to learners at the start of the examination.
- **Part B** should be given to learners after 45 minutes has passed.
- **Part A** and **Part B** are specific to each series and this material must only be issued to learners who have been entered to undertake the task in the relevant series.
- **Part B** should be kept securely until the start of the 1 hour and 30 minute supervised assessment period.
- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and learner registration number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*

Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ▶

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Answer ALL questions in Section 1 and Section 2.

Write your answers in the spaces provided.

SECTION 1

You should use the research scientist's draft report and your notes from Part A to complete Section 1.

1 (a) Record the research scientist's raw data in a suitable table, using the space provided.

Your table must include the average *Pleurococcus* percentage cover at each directional aspect.

Circle any anomalous results.

You do **not** need to include light intensity readings in this table.

(3)

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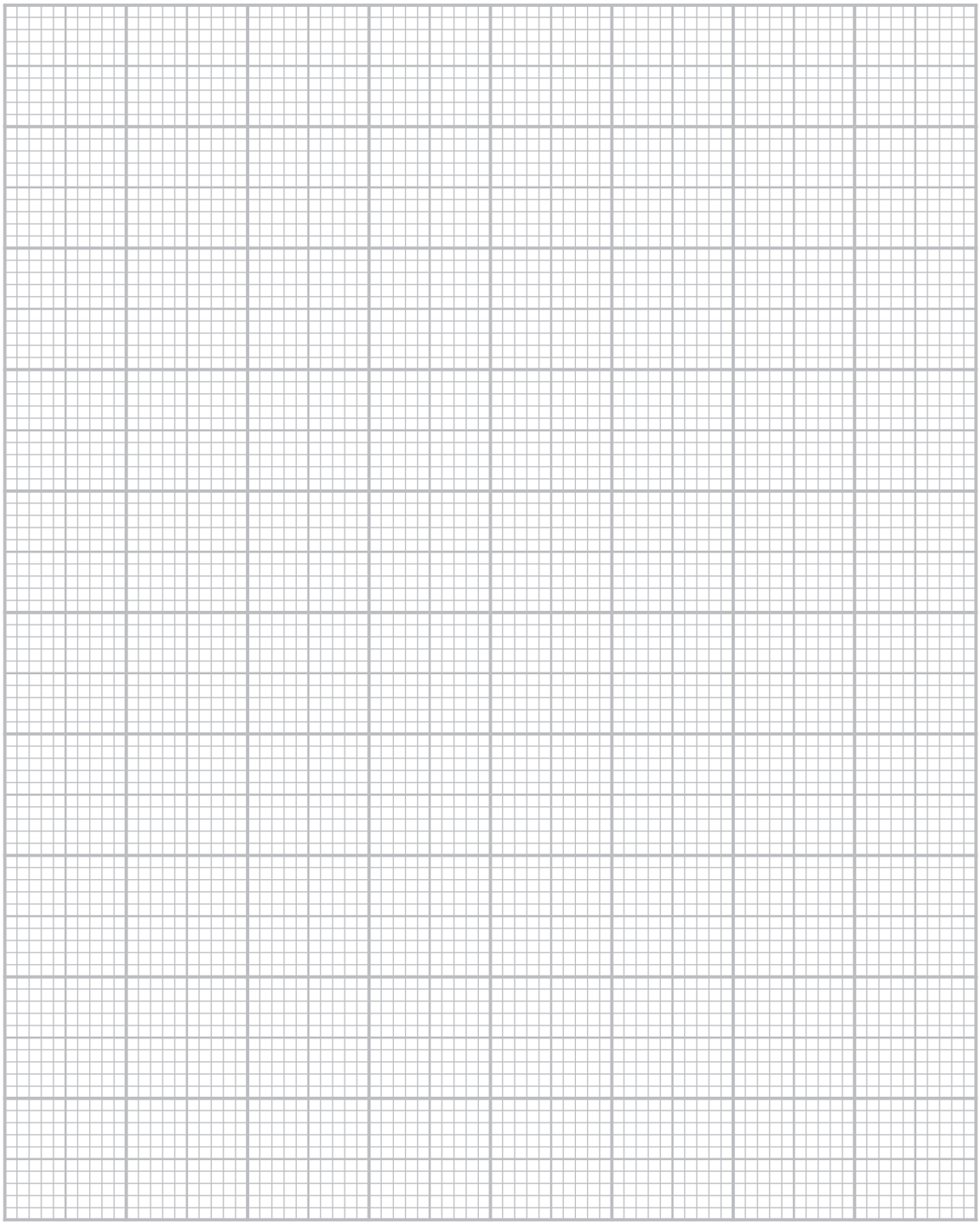
(b) Draw a bar graph to show average percentage cover of *Pleurococcus* against the directional aspects around the tree trunks.

(3)



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(c) Describe, using information in your graph, the relationship between the average percentage cover of *Pleurococcus* and the directional aspects around the tree trunks.

(2)

(d) One hazard in the research scientist's investigation was uneven surfaces.

Identify **one other** hazard in the investigation.

(1)

(e) (i) Abiotic factors can affect the growth of the *Pleurococcus*.

State the meaning of the word **abiotic**.

(2)

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(ii) Explain how light intensity affects the percentage cover of *Pleurococcus*.

Use the research scientist's raw data in the **Part A** taskbook to support your answer.

(3)

(f) The method in **Part A** needed measurements to be taken at 1.5 m above the ground.

Give **two** reasons why measurements were taken at 1.5 m above the ground.

(2)

1

2

(Total for Question 1 = 16 marks)

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2 (a) The research scientist's supervisor did a similar investigation.

The supervisor used a light meter that had a maximum error (uncertainty) of 0.05 lux when the measured value was 7600.0 lux.

Calculate the percentage error in the measurement.

(2)

Show your working.

Use the equation:

$$\text{percentage error} = \frac{\text{maximum error}}{\text{measured value}} \times 100$$

percentage error = ... %

(b) The supervisor measured the percentage cover of *Pleurococcus* on the north side of two different types of tree: pine and oak.

(i) State a null hypothesis for the supervisor's investigation.

(2)

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(ii) Table 1 shows percentage cover of algae on the north side of 15 pine trees and 15 oak trees.

Experimental repeat	Percentage cover (%)	
	Pine	Oak
1	88.0	91.0
2	94.0	92.0
3	87.0	87.0
4	89.0	88.0
5	92.0	91.0
6	90.0	89.0
7	97.0	90.0
8	82.0	88.0
9	88.0	92.0
10	96.0	92.0
11	94.0	91.0
12	83.0	86.0
13	88.0	89.0
14	90.0	92.0
15	94.0	91.0
Mean percentage cover (%)	90.1	89.9
Standard deviation (s)	4.41	1.98

Table 1

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Calculate, using the unpaired *t*-test, the value of *t* for the supervisor's results.

(6)

Use the equation:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

Show your working.

t = ...

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(iii) Calculate the degrees of freedom for the supervisor's results.

(2)

Use the equation:

$$(n_1 + n_2) - 2$$

Show your working.

degrees of freedom = ...

(iv) Give the critical value of *t* at the p = 0.05 level.

(1)

Use the *t* table shown.

		p = 0.05
Degrees of freedom	23	2.069
	24	2.064
	25	2.060
	26	2.056
	27	2.052
	28	2.048
	29	2.045
	30	2.042

Table 2 – *t* table

critical value of *t* = ...

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(v) Explain whether the null hypothesis should be accepted or rejected.

(3)

(Total for Question 2 = 16 marks)

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3 (a) (i) Wind varies in an ecosystem and could not be controlled in the research scientist's investigation.

Explain how an increase in the speed of wind could have affected the research scientist's results.

(2)

.....

.....

.....

.....

(ii) Identify **two other** variables in the research scientist's investigation that could not be controlled.

(2)

1 .....

.....

2 .....

.....

(b) Explain **two** ways you could improve the research scientist's investigation to provide a more accurate value for the percentage cover of *Pleurococcus*.

(4)

1 .....

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(Total for Question 3 = 8 marks)

TOTAL FOR SECTION 1 = 40 MARKS

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SECTION 2

4 The alcohols are a group of organic compounds. Alcohols can be used as fuels.

Table 3 shows five alcohols and the number of carbon atoms per molecule.

alcohol	number of carbon atoms per molecule
methanol	1
ethanol	2
propan-1-ol	3
butan-1-ol	4
pentan-1-ol	5

Table 3

When alcohols are burned they release heat energy.

You have been asked to write a plan for an investigation into how the number of carbon atoms in an alcohol molecule affects the amount of heat energy produced per gram of alcohol.

Your plan should include the following details:

- a hypothesis
- selection, and justification, of equipment, techniques or standard procedures
- health and safety associated with the investigation
- a step-by-step method for data collection and analysis to test the hypothesis including:
  - quantities to be measured
  - number and range of measurements to be taken
  - how equipment may be used
  - control variables
  - brief method for data collection analysis.

(12)

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5 A learner wanted to find out which of four snack foods contained the most energy.

The learner investigated the energy content of different types of snack food.

Here is the learner's method.

- Fill a test tube half way with water.
- Measure the initial temperature of the water.
- Place one snack on a mounted needle.
- Set the snack alight and place it under the test tube containing the water.
- Measure the final temperature of the water.

Table 4 shows the results of the learner's investigation.

type of snack food	starting temperature of the water (°C)	final temperature of the water (°C)
onion ring	24	56
cheese ball	26	51
bacon fry	22	55
prawn cocktail shell	25	45

Table 4

The learner concludes that:

'The snack with the highest energy content is the onion ring because the final temperature of the water is the highest. Next is the bacon fry then the cheese ball, and the prawn cocktail shell has the lowest energy content.'

Evaluate the learner's investigation.

Your answer should make reference to the:

- method of the experiment and equipment used
- results collected
- conclusion made.

(8)

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(Total for Question 5 = 8 marks)

TOTAL FOR SECTION 2 = 20 MARKS
TOTAL FOR PAPER = 60 MARKS

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